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Does cucumber production affect land productivity and profitability? New evidence from Imo State, Nigeria

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ABSTRACT

The overall objective of this study is to examine the productivity and profitability of cucumber production in Imo State, Nigeria. A multistage sampling technique was used to select 216 cucumber farmers who were administered a questionnaire. Data were collected from primary sources and analyzed using descriptive statistics, budgeting principles, total and partial factor productivity model, and ordinary least square multiple regression approach. The mean productivity ratio of 0.0049 was used to isolate the land productivity levels of cucumber farmers into high and low degrees. Owerri zone had total factor productivity (TFP) and partial factor productivity (PFP) of 2.11 and 22.9, Okigwe had TFP and PFP of 2.69 and 31.0, and Orlu zone had 3.43 and 36.5 respectively. Age, gender, family size, farm size, education, farming experience, cooperative membership, and extension contacts were important and significant factors affecting net returns and land productivity of farmers in the state. Previous studies reported non-significance of age, education, and farming experience, which is completely different from the results of this study. Cucumber production and marketing were mainly constrained by low capital (100%), high labor costs (92.1%), and high input costs (94.4%). Cucumber production in the state was lucrative, profitable, and economically viable as evidenced by a net return of ₦53547.06.

1. Introduction

Cucumber (*Cucumis sativus*) is an important crop that is widely grown in Nigeria's various agroecological zones (FAO, 2021). This stretches from the rainforest to the savannah zones of Nigeria, with the production pattern and volume varied by location. Plateau, Kaduna, Katsina, Kano, and Nassarawa are the primary cucumber-producing states in northern Nigeria, whereas Imo, Benue, Enugu, Ebonyi, Akwa-Ibom, Oyo, Cross River, and Rivers are the major cucumber-producing states in the southern zone (Amanullah et al., 2020). Cucumber, a member of the Cucurbitaccae family, is one of the most significant exotic vegetables and the fourth most extensively farmed vegetable in the world (FAO, 2020a). It is one of the most important vegetables grown by Nigerian domestic farmers due to its health benefits. Its production continues to gain popularity in Nigerian communities because of its nutritional and economic benefits (Abdulkadir et al., 2020). Cucumber is eaten fresh, as a dessert after meals, processed into juice, or combined with other foods. Cucumber cultivation has the potential to increase agricultural productivity, economic empowerment, and food security in Nigeria due to its demand and output markets, according to empirical evidence (Anthony et al., 2021). Cucumber

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production in Nigeria is progressively exceeding domestic production and consumption and is now being shipped to neighboring West African nations such as Chad, Cameroon, Niger, and Benin Republics (FAO, 2020b). Cucumber cultivation, like other crops, requires suitable climatic and environmental conditions to facilitate growth and output. Cucumber production is similarly cost-effective, allowing cucumber growers to optimize economic returns (Ayi, 2022). Proper agronomic methods such as frequent weeding, timely irrigation, fertilizer application, and timely harvesting are required for high-yield and quality fruit production. It has been recognized that higher agricultural output will aid in achieving the necessary food security in Nigeria, as well as an increase in household farmer income (FAO, 2021). Agricultural productivity is the output produced by a given level of inputs. Productivity can be measured as partial or total. Partial factor productivity (PFP) is the ratio of a measure of output quantity to the quantity of a single input used (FAO, 2020a). Total factor productivity (TFP) is the ratio of a measure of total output quantity to a measure of the quantity of total inputs (Yaduma et al., 2020). A rise in output and inputs with output rising proportionally higher than inputs is necessary to boost agricultural productivity, along with a rise in production. To alleviate extreme poverty, promote shared prosperity, and feed an estimated 9.7 billion people by 2050, consideration is given to the land productivity of the farmer which in turn determines the profitability of the farmers (FAO, 2019) and this can only be achieved if the productivity of the land is maintained at all times via effective application of enhanced and sustainable farming methods that are both economically viable and environmentally beneficial (Dokic et al., 2022). In recent times, cucumber farmers in the State have experienced a severe decline in production resulting in decreased yields, reduced quality, and quantity as well as loss in economic value and market returns, thereby subjecting them to hunger, starvation, poverty, and economic hardship (Fanelli, 2022). Their land productivity is seriously threatened which has affected their economic returns. Currently, the growing population in the state is driving up the demand for vegetable production, and cucumber is a significant fruit and vegetable crop that is struggling to keep up as crop yield decreases intensely due to inherent production factors and adverse climatic conditions prevalent in the state (Onyeneke et al., 2021).

However, before now, various studies (Alawode et al., 2020; Amanullah et al, 2020; Dokic et al., 2022; de la Fuente et al., 2020; Jianxu et al., 2020) had assessed the productivity and profitability of other agricultural crops such as (cassava, rice, wheat, sorghum, maize, yam, etc.) in Nigeria and other countries of the world, while the few studies on cucumber (Abdulkadir et al., 2020; Bernard and Japhet 2021; Igwe et al., 2020) were explored using minor descriptive statistics such as mean, percentages, etc. Interestingly of all the studies conducted in Nigeria, none had examined cucumber production with respect to farmers' land productivity and profitability using budgeting principles, total factor and partial factor land productivity models, returns on investment model, and ordinary least square multiple regression model, hence the gap in knowledge, motivation and novelty of the study. Furthermore, in comparison to prior research, this study buttresses advancements in scientific knowledge and in the econometric models employed, which differ entirely from other previous studies. The specific objectives of this study were to identify the socio-economic characteristics of the cucumber farmers, land productivity ratio of cucumber farmers, productivity differences of cucumber farmers across the state, marketing channels of cucumber farmers, costs and returns of cucumber production, socio-economic factors influencing net returns and land productivity of cucumber farmers, and production/marketing constraints of cucumber farmers.

2. Materials and methods

The study was conducted in Imo State, Nigeria. Imo State was chosen because of its agrarian dominance and high concentration of cucumber producers. The selection of samples was done using a multi-stage sampling process. Two local government areas (LGAs) were randomly selected from each of the state's three agricultural zones (Orlu, Owerri, and Okigwe), yielding a total of six LGAs in the first stage. Three communities were chosen at random from the aforementioned LGAs for the second stage, bringing the total to 18 communities. A further random selection of two villages from each of the aforementioned communities was made in the third step, bringing the total to 36 villages. In the fourth step, 7 cucumber growers were chosen from all of the villages, making a sample size of 252 farmers. The list of registered cucumber farmers obtained from the state agricultural development program formed the sample frame. Primary data were collected for the study. The survey instrument (questionnaire) was used for primary data collection. It was prepared following the specific objectives of the study and was administered in person to the sampled respondents, only 216 of the questionnaires were ultimately judged to be suitable for data analysis due to the valid and appropriate information provided. The questionnaire was tested and retested to ensure its applicability and was evaluated with a sample of 20 respondents before actual data collection. For analysis, the acquired data were normalized, sorted, coded, and placed into an Excel sheet. Data analysis was done using descriptive statistics, costs and return analysis cum return on investment, total and partial factor productivity model, and ordinary least square multiple regression techniques. Descriptive statistics involves the use of mean, frequency, and percentages. Costs and returns

analysis made use of the net returns principle such as

$$NR = TR - TC \quad (1)$$

where, *NR* is net returns, *TR* is total revenue, and *TC* is total cost.

$$ROI = \frac{NR}{TC} \quad (2)$$

where, ROI is returns on investment.

$$TFP = \frac{TO}{TI} \quad (3)$$

where, TFP is total factor productivity' TO is total output, and TI is total Input.

$$PFP = \frac{TO}{ith\ Ipt} \quad (4)$$

where, PFP is partial factor productivity, ithIpt is individual inputs used.

The ordinary least square multiple regression technique is specified as follows for cucumber net returns and the ordinary least square multiple regression technique is specified as follows for cucumber land productivity.

$$Y = F(X_1\ X_2\ X_3\ X_4\ X_5\ X_6\ X_7 X_8,\ X_9) + ei \quad (5)$$
$$Y = F(X_1\ X_2\ X_3\ X_4\ X_5\ X_6\ X_7 X_8,\ X_9) + ei \quad (6)$$

where, Y in Eq. 5 is net returns (Naira), Y in Eq. 6 is cucumber output (Kg), X_1 is age (Number of years), X_2 is gender (Male =1; Female = 0), X_3 is the household size (Number of persons), X_4 is farm size (Hectare), X_5 is education (Number of years spent in school), X_6 is the farming experience (Number of years), X_7 is the marital status (Married =1; Single =0), X_8 is membership in cooperative (Member =1, Non-member =0), X_9 is extension contact (Number of visits), and ei is the error term.

3. Results and discussion

3.1. Socio-economic characteristics of cucumber farmers

The socioeconomic traits of cucumber farmers are displayed in Table 1. According to Table 1, 67.6% of the cucumber growers were in the 40–49 age range, with a mean age of 43. This suggests that the cucumber farmers are relatively young and within their productive age, which may be used to boost the State's cucumber farm production. Younger farmers are considered to be more active and enthusiastic in agricultural output as opposed to older farmers, who are becoming weak and sedentary. This result is similar to the findings of Walid et al., (2020) and opposed the findings of Guo et al., (2015). The gender distribution revealed that female farmers made up 72.7% of all cucumber growers in the state, compared to male farmers' 27.3%. This suggests that women were more likely than males to produce cucumbers in the region. It is perceived that producing cucumber is a feminine job; hence, there are more female farmers than male farmers (FAO, 2020b).

Table 1: Socio-economic characteristics of cucumber farmers

Variable	Frequency	Percentage	Mean
Age			43.0
30 – 39	36	16.6	
40 – 49	146	67.6	
50 – 59	22	10.2	
60 and above	12	5.6	
Gender			
Male	59	27.3	
Female	157	72.7	
Household size			7
1-4	12	5.5	
5-9	187	86.6	
10-14	17	7.9	
Farm size			2.4
0.1-1.0	13	6.0	
1.1-2.0	15	7.0	
2.1-3.0	188	87.0	
Education			
No formal education	19	8.8	
Primary education	52	24.1	
Secondary education	59	27.3	
Tertiary education	86	39.8	
Farming experience			7
1-5	55	25.5	
6-10	157	72.7	
11-15	4	1.8	
16-20	-	-	
21 and above	-	-	
Marital status			
Married	188	87.0	
Single	28	13.0	
Cooperative membership			
Member	127	58.8	
Non-member	89	41.2	
Extension contacts			
Contact	138	63.9	
No Contact	78	36.1	

The result contradicts the findings of Bello et al., (2021) who reported more male farmers in crop production. The average household size of cucumber growers was 7 and the bulk of them- 86.6%-lived in homes with between 5 and 9 people. This suggests that the household sizes of the cucumber producers were quite big, which may be used to increase the state's cucumber production. The mean farm size was 2.4 hectares, with the majority of farmers (87.0%) between 2.1 and 3.0 hectares in size. This shows that the cucumber growers farmed an area larger than 2 hectares. Large farm sizes give farmers the opportunity to start large-scale farming. This corresponds to the findings of Bernard and Japhet, (2021) and contradicts Omotilewa et al. (2021). The majority of cucumber farmers, 39.8%, attended tertiary institutions, suggesting that they were trained to comprehend the dynamics and methods of cucumber farming that might lead to a rise in output in the State (Igwe et al., 2020). Cucumber farmers had an average of 7 years of agricultural experience, with 72.7 percent of them having between 6 and 10 years. This suggests that the typical cucumber farmer has seven years of farming experience, which is relatively sufficient to boost cucumber production, and this confirms the result of Mouayadi et al. (2020) and disagrees with the findings of Zhou and Li

(2022). According to marital status, married people 87.0% produced more cucumbers than unmarried people (13.1%). This suggests that married people were more involved in cucumber production than unmarried people. Once more, 58.8% of cucumber producers, as opposed to 41.2 percent, are members of cooperative groups. Cooperative society membership has several advantages, and being a member boosts a farmer's access to improved and subsidized farming inputs and other welfare benefits granted to such an association. This contradicts the findings of Igwe et al. (2020). The majority of cucumber farmers, 63.9 percent, had contacts with extension agents; this suggests that the majority of cucumber growers in the state had sufficient hands-on field experience geared toward raising cucumber yield and productivity. Extension services help farmers to learn new things, and adapt what they have learned to their advantage (FAO, 2020a).

3.2. Land productivity ratios of cucumber farmers

The land productivity ratio of cucumber farmers is presented in Table 2.

Table 2: Land productivity ratios of cucumber farmers

Productivity ratios	Frequency	Percentage
0.001-0.009	19	8.8
0.010-0.019	33	15.3
0.020-0.029	27	12.5
0.030-0.039	23	10.7
0.040-0.049	29	13.4
0.050-0.059	54	25.0
0.060-0.069	15	6.9
0.070-0.079	16	7.4
Total	216	100
Mean	0.049	
SD	0.0891	

From Table 2, the land productivity levels of the cucumber producers were classified using the mean productivity ratio of 0.049. According to the mean, cucumber farmers below or equal to the mean were adjudged to have low productivity ratios while those above the mean were adjudged to have high productivity ratios. This implies that about 61 percent of cucumber growers were found to have low productivity ratios, while the remaining 39% were ascertained to have high productivity ratios. This could be a result of production inherent factors influencing the cucumber farmers in the state; this result is similar to the findings of de la Fuente et al. (2020). A quarter of the cucumber producers had productivity ratios of between 0.05 and 0.059, demonstrating their ability to make the most of the scarce resources at hand while also increasing output and, consequently, land productivity. In a similar vein, 7.4 percent of cucumber growers were found to have productivity ratios between 0.070 and 0.079, suggesting that these growers had the greatest productivity ratios in the state. The high production ratios may be due to farmers' exposure to agricultural knowledge, farm innovations, agricultural seminars, and conferences, in addition to extension contact services (FAO, 2021). These mediums help farmers become more creative and knowledgeable in producing vegetables in an efficient and successful manner. The low productivity ratios of the cucumber farmers, however, might be attributed to their conservative nature and inexperience in vegetable cultivation. This is equally reported by FAO (2021) and contradicts Omotilewa et al. (2021).

3.3. Productivity differences of cucumber farmers across the zones

The productivity difference of cucumber farmers across the zones is presented in Table 3.

Table 3: Productivity differences of cucumber farmers across the zones

Zone	Mean outputs	Mean inputs	TFP	PFP
Owerri	7790166.80	3690865.09	2.11	22.9
Okigwe	8869032.01	3298641.02	2.69	31.0
Orlu	7490432.91	2182349.81	3.43	36.5
Total	24149631.71	9171855.91	8.23	90.4

Table 3 shows both the total factor productivity (TFP) and partial factor productivity (PFP) of the cucumber farmers across the zones in the state. From Table 3, the Okigwe zone recorded an overwhelming increase of 114 percent in mean output against the Owerri zone and a 118 percent increase against the Orlu zone. This implies that cucumber farmers in the Okigwe zone efficiently maximized their resource inputs to achieve such a feat. Dokic et al. (2022) reported similar findings in their study. This is equally reflected in both TFP and PFP which are higher than the ones obtained in the Owerri zone and interestingly lower than that of the Orlu zone. Similarly, the Owerri zone had over a 112 percent increase in mean inputs against the Okigwe zone and a 169 percent increase over the Orlu zone; this equally implies the high cost of planting inputs in the Owerri zone relative to the other two zones. This could be due to its metropolitan nature and position as the State Capital. Consequently, the Orlu zone obtained the lowest mean output and input as shown in Table 3 but however, but with outstanding performance both in TFP and PFP. This is interesting and implies that the Orlu zone outperformed the other two zones (Owerri and Okigwe) in terms of TFP and PFP respectively. This could be a result of efficient and effective utilization of available farm resources. However, the overall (TFP and PFP) across the zones was estimated at 8.23 and 90.4, this further implied a high productivity level of cucumber production in the entire zone. The high productivity level recorded in the state could result from the commitment and dedication of the cucumber farmers to their farm production, this agrees with the findings of Anthony et al. (2021).

3.4. Marketing channels of cucumber farmers

The marketing channels for the selling of cucumbers are displayed in Table 4. Table 4 reveals that the cucumber producers offered their goods for

sale in three distinct places. About 24 percent of the cucumber farmers disposed of their produce right at the farm gate level; this is probably due to the remoteness of the market coupled with their inability to access the market due to transportation difficulties and the nature of the roads leading to the markets. Many farmers occasionally choose to buy agricultural products at the farm gate level rather than in the marketplace, the result confirms the findings of Jianxu et al., (2020) and contradicts de la Fuente et al. (2020). The majority of cucumber farmers, 49 percent, went to the local market since it was close by; while the urban market had about 28 percent of the cucumber farmers due to their ease of transportation to such markets as well as profit making. The result implied that the cucumber farmers marketed their produce with respect to market proximity, ease of cucumber sale, and transportation (Amanullah et al., 2020).

Table 4: Marketing channels of cucumber farmers

Marketing channels	Frequency	Percentage
Farm gate	51	23.6
Local market	105	48.6
Urban market	60	27.8
Total	216	100

3.5. Costs and returns of cucumber production (profitability)

The costs and returns of cucumber production are presented in Table 5. Table 5 reveals that the cucumber farmers made revenue of ₦104000 from the sale of 26 bags of cucumber pods. This showed that the farmers produced on average 26 bags of cucumber pods which are relatively higher quantities of cucumber pods produced in the state. The total variable cost was estimated at ₦28803.06, this indicated all the variable costs of production incurred in cucumber production such as labor, agrochemicals, organic fertilizer, etc. The result also conforms to the findings of Fanelli (2022). Again the total fixed cost was estimated at ₦21649.88, this includes all the fixed items/costs incurred during cucumber production such as rent, interest on loans, taxes, and depreciation of fixed items. Yaduma et al. (2020) reported similar results in their findings. The total cost was estimated at ₦50452.94 which is a cumulative of total variable cost and total fixed cost. Furthermore, the result gave net returns of ₦53547.06, which implies that cucumber production in the state was profitable and economically viable and therefore should be encouraged in the state. The net returns realized further showed that the cucumber farmers were able to maximize profit and minimize losses as evidenced in the monetary value obtained from the variable cost of production. Again, the return on investment gave a value of 1.06, implying an increasing rate of investment returns on cucumber production. This further showed that for every ₦1.00 invested, ₦1.06 kobo was realized, and this implies 106 percent returns on investment.

Table 5: Costs and returns of cucumber production

Items	Amount (Naira)
A. Revenue (26 bags of cucumber pods sold at ₦4,000/bag)	104000
Variable cost	
Labor (planting, weeding, harvesting, etc.)	8500.61
Organic fertilizer used	4250.85
Agrochemical (Insecticides)	1500.89
Improved seedlings planted	3833.33
Transportation cost to market	2595.83
Packaging/loading and offloading cost	2602.04
Storage cost	3550.84
Others (feeding cost, etc.)	1968.67
B. Total variable cost	28803.06
Fixed cost	
Land rent	10272.50
Interest on loans	7027.59
Depreciation of fixed items	2560.03
Taxes/levies	1789.76
C. Total fixed cost	21649.88
D. Total cost (B + C)	50452.94
Net return (A-D)	53547.06
Return on investment	1.06

3.6. Socio-economic factors influencing net returns of cucumber farmers

The determinants of socio-economic factors influencing the net returns of cucumber farmers are presented in Table 6.

Table 6: Multiple regression determinants of socio-economic factors influencing net returns of cucumber farmers

Variable	Linear	Exponential	Semi-log	Double-log
Constant	233.071	8.30105	-62.4438	7.2889
	(1.004)	(37.48)***	(-0.874)	(10.32)***
Age (X1)	-2.3851	0.0029	-4939.07	0.0298
	(-0.064)	(0.511)	(-0.277)	(0.185)
Gender (X2)	-529.463	-0.06899	-924.908	-0.05871
	(-2.062)**	(-2.758)**	(-0.450)	(-0.287)
Household size (X3)	-215.714	-0.01360	-1035.55	-0.0809
	(-1.112)	(-0.711)	(-1.28)	(-1.007)
Farm size (X4)	1038.16	0.09490	3274.89	0.30129
	(1.04)	(3.81)***	(4.100)***	(3.82)***
Education (X5)	385.55	0.94402	3989.79	0.45100
	(4.210)***	(5.028)***	(4.076)***	(4.66)***
Experience (X6)	361.304	0.02856	3989.79	0.18822
	(1.43)	(3.16)***	(1.06)	(0.84)
Marital status (X7)	-715.26	-0.10799	-260.932	-0.0965
	(-1.029)	(-1.214)	(-0.149)	(-0.556)
Membership in cooperative (X8)	2383.87	0.65876	0.59902	0.36588
	(1.44)	(3.602)***	(2.14)**	(1.99)*
Extension contact (X9)	58.8981	74.0981	0.98423	56.9530
	(1.99)*	(3.099)***	(2.190)**	(0.451)
R2	0.689	0.898	0.599	0.696
F- ratio	11.307***	22.28***	16.54***	9.4***

***, **, and *: Significant at 1%, 5%, and 10%, respectively

In Table 6, four functional forms of linear, exponential, semi-log, and double log were fitted into the regression line and the exponential form offered the best fit and was chosen as the lead equation since it had the highest coefficient of multiple determinations (R^2) value, the highest number of significant variables, and the highest F-value. The R^2 of 0.898 demonstrated that the socioeconomic variables investigated were responsible for 89.8% of the overall changes in the dependent variable (net returns). The model provided a best fit as indicated by the F-value of 22.28. At a 5% level, the gender variable was statistically significant and negatively skewed. This suggests that in comparison to their male counterparts, female farmers received higher net returns from cucumber production. This is possible because more female farmers than male farmers are involved in the state's cucumber production. The farm size coefficient was positive and significant at the 1% level, suggesting that any increase in farm size will correlate to an increase in the net returns of the cucumber growers. This is true because greater farmland encourages more land cultivation, which leads to more productivity and higher net returns. This result agrees with the findings of Jianxu et al. (2020) and contradicts Omotilewa et al. (2021). The education coefficient was positive and statistically significant at the 1% level, suggesting that a 1% improvement in the educational level of cucumber producers will translate into a 94.4 % rise in their net returns. According to Table 1, the cucumber growers had high levels of education, which undoubtedly helped them maximize revenues and reduce losses. The farming experience coefficient was similarly positive and statistically significant at the 1% level, suggesting that any improvement in the farming experience of the cucumber farmers will result in an increase in net returns. This generally indicates that an increase in farming experience positively translates to improved production and net returns. The result validates the findings of Richard and Fred (2020) and opposed the findings of Jianxu et al. (2020). Cooperative membership was statistically significant at the 1% level, indicating that an increase in cooperative membership will correlate to an increase in the cucumber producers' net returns. In other words, joining cooperative organizations gives cucumber growers access to pertinent information and subsidized farming inputs like seedlings, agrochemicals, capital, etc., which leads to a rise in farm output and net profits. The result is an affirmation of Alawode et al. (2020). The coefficient of extension contact was similarly positive and significant at the 1% level, suggesting that a 1% increase in cucumber farmers' access to extension contact will result in a 7409 percent increase in their net returns. Extension services provide farmers with the necessary access to essential knowledge and hands-on expertise in farm production which results in increased net returns. The result agrees with the findings of Dokic et al. (2022) and disagrees with Zhou and Li (2022).

3.7. Multiple regression determinants of land productivity of cucumber

The multiple regression determinants of land productivity of cucumber are presented in Table 7.

Table 7: Multiple regression determinants of land productivity of cucumber

Variable	Linear	Exponential	Semi-log	Double-log
Constant	4303.01	7.001	414031	3.2092
	(1.201)	(2.078)**	(-0.414)	(4.72)***
Age (X1)	2.4480	0.90299	4929.57	0.84999
	(2.562)**	(0.811)	(0.777)	(3.103)***
Gender (X2)	-429.16	-0.378	-622.008	-0.9880
	(-2.512)**	(-2.978)**	(-0.100)	(-3.207)***
Household size (X3)	919.724	0.4144	4015.95	0.7781
	(1.415)	(0.011)	(3.088)***	(1.007)
Farm size (X4)	4031.10	0.7988	42664.89	9.3519
	(1.047)	(2.819)**	(3.190)***	(3.929)***
Education (X5)	581.053	0.78499	5921.76	0.8553
	(3.230)***	(1.008)***	(3.086)***	(3.869)***
Experience (X6)	463.344	0.4428	9980.29	4.1481
	(1.933)*	(3.061)***	(1.469)	(2.841)**
Marital status (X7)	-914.230	-0.3088	-365.333	-9.4764
	(-1.229)	(-1.012)	(-0.219)	(-0.056)
Membership in cooperative (X8)	3382.07	888.099	99.0355	0.56588
	(0.540)	(0.438)	(1.691)*	(2.792)**
Extension contact (X9)	0.56781	0.87521	7.09632	9.54321
	(1.26)	(2.89)**	(0.988)	(2.666)**
R2	0.779	0.708	0.691	0.896
F-ratio	12.07***	16.88***	10.54***	21.4***

***, **, and *: Significant at 1%, 5%, and 10%, respectively

In Table 7, four functional forms of linear, exponential, semi-log, and double log were fitted into the regression line and the double-log functional form was selected as the lead guide because of its exceptional number of significant variables, highest R^2, and best F-ratio. The overall fitness of the model was demonstrated by the F-value of 21.4. The R^2 value of 0.896 further demonstrated that the independent variables examined explained 89.6% of the overall variability in the dependent variables. The age coefficient was positive and significant at a 1% level of probability, indicating that an increase in the age of the cucumber farmers will lead to a corresponding increase in the land productivity of

cucumber farmers. This also implies that as farmers become older, their output capacity rises, thus increasing land productivity, this agrees with FAO (2021). Gender showed a negative coefficient and was significant at the 1% level of probability, suggesting that more female farmers were deeply involved in cucumber production and obtained higher land productivity than male farmers. This also shows that cucumber cultivation is adjudged a feminine occupation. The result affirms the findings of Oluwalana et al. (2019) and opposed the findings of Guo et al. (2015). The size of the farm was also positive and significant at the 1% level of probability, suggesting that as the size of the farm increases, so do the levels of output and land productivity. Increased farmland generally increases the land productivity of the farmers, this agrees with Idris-Adeniyi et al. (2021). Education was positive and significant at the 1% level of probability, suggesting that any rise in educational attainment among cucumber growers will be accompanied by an equivalent rise in output and land productivity. Hence, any improvement in the educational level of cucumber farmers in the state will result in an increase in land productivity of roughly 85.5 percent. Education is a crucial instrument to improve farmers' land productivity and agricultural production at all times, the result contradicts Samson and Isaac (2020) who reported negative outcomes of education. Once more, the coefficient of farming experience was positive and significant at 5%, indicating that as cucumber farmers gain more farming expertise, their land productivity rises simultaneously. The cooperative coefficient was positive and significant at a 5% level, indicating that as farmers join cooperatives; their land productivity rises. This is because being a member of a cooperative society benefits farmers in terms of input supplies which increases land productivity (Abdulkadir et al., 2020). The extension coefficient was similarly positive and significant at the 5% level, indicating that a 1% increase in extension services will result in a 954.3% increase in cucumber growers' land productivity. Extension services help farmers transition from low productivity to high productivity levels in agriculture and agree with the reports of FAO (2019).

3.8. Production/marketing constraints of cucumber farmers

The production/marketing constraints of cucumber farmers are presented in Table 8. Table 8 reveals that multiple responses were obtained regarding the production and marketing constraints of cucumber farmers. It indicated that the cucumber farmers had difficulty accessing credits from commercial and agricultural banks. The farmers averred that their inability to provide collateral services required by the banks prevented them from accessing credits while the majority of the farmers were discouraged by high interest rates charged by the banks (FAO, 2020b). About 23 percent of the farmers complained about a lack of good storage facilities, while over 40 percent reported a lack of adequate extension services. Cucumber being a perishable vegetable requires good storage facilities, which were not readily available. The result tallies with the findings of Walid et al. (2020). Extension services are instruments of positive changes in relation to farming but were not accessed by a minority of the cucumber farmers being that they are hardly around whenever extension agent visits. Again, the high cost of farm inputs, labor, pest/disease attacks, and poor weather conditions were reported by 316.1 percent of the cucumber farmers. It could be deduced from the study that cucumber farmers would have recorded more increasing rate of cucumber production and productivity if not for the high cost of farm inputs, labor, pest/disease attacks, and poor weather conditions. The result corresponds with the findings of FAO (2021). Again, farmers indicated a lack of access to markets, 77.3 percent, theft, 86.6 percent, spoilage, 21.8 percent, and low/poor market patronage, 88.4 percent respectively. These indicated factors obviously marred both the production and marketing potentials of the cucumber farmers and, as a result, affected their net income and/ or profit levels; this is affirmed by Abdulkadir et al. (2020).

Table 8: Production/marketing constraints of cucumber farmers

Problem	Frequency	Percentage
Lack of access to credit	216	100
Lack of storage facilities	49	22.7
Lack of extension services	88	40.7
High cost of farm inputs	204	94.4
High cost of labor	199	92.1
Pest/disease attack	189	87.5
Poor weather conditions	91	42.1
Lack of access to markets	167	77.3
Theft	187	86.6
Spoilage	47	21.8
Low/poor market patronage	191	88.4

4. Conclusion

In Nigeria, the cultivation of cucumber has emerged as a significant crop among other vegetable crops. Its economic and nutritional benefits have been recognized since it boosts vegetable food supply. About 67.6% of the cucumber growers are relatively young and within their productive age, which could be utilized to boost cucumber production in the state. The result shows that about 61 percent of cucumber growers were found to have low productivity ratios, while the remaining 39% were ascertained to have high productivity ratios judging from the estimated mean productivity ratio. The overall TFP and PFP across the zones were estimated at 8.23 and 90.4, this shows a very high

productivity level of cucumber production in the state. The majority of cucumber farmers marketed their cucumber produce at the local market because of its proximity. A net return of ₦53547.06 was realized from cucumber marketing which implies that cucumber production in the state was profitable and economically viable. Age, gender, family size, farm size, education, farming experience, cooperative membership, and extension contacts interfered with the net returns and land productivity of the cucumber producers. Cucumber production and marketing were constrained by capital, labor costs, input costs, lack of storage facilities, pests and diseases, and poor weather conditions. Farmers should be encouraged to go into full-scale cultivation of cucumber since it is profitable and economically viable.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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